

## The impact of calving season, dams' parity on milk yield and gestation length of dairy cows

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**Abstract:**The purpose of the study was to assess the effect of calving season and dams' parity on milk yield and gestation length of dairy cows. We examined 93 animals of Slovak spotted breed from the farm located in western Slovakia (Lower Váh region), in years 2014–2017. The herds' average 305-d milk yield was  $8,133 \pm 1,380$  kg. The calving season was divided into four categories: spring (March to May), summer (June to August), autumn (September to November) and winter (December to February). The factor of dams parity was divided into 4 groups: 1<sup>st</sup> parity cows, 2<sup>nd</sup>–3<sup>rd</sup> parity cows, 4<sup>th</sup> and higher parity cows. Calving season affected significantly milk yield of dairy cows ( $P < 0.01$ ). The highest 305-d milk production was observed in winter calvings ( $8,942 \pm 218$  kg) and the lowest in spring calvings ( $7,377 \pm 287$  kg). The gestation length was not significantly altered by calving season ( $P > 0.32$ ). Dams' parity was not significantly affected by 305-d milk yield ( $P > 0.22$ ). Nevertheless, the animals on the 4<sup>th</sup> and higher lactation were numerically more productive ( $8,481 \pm 259$  kg) compared to the dairy cows on their 1<sup>st</sup>, 2<sup>nd</sup>–3<sup>rd</sup> lactation ( $8,123 \pm 264$  kg;  $7,884 \pm 223$  kg; resp.). The dams' parity significantly affected gestation length ( $P < 0.02$ ), with the shortest gestation length in 1<sup>st</sup> parity dams ( $278 \pm 2$  days) and the longest gestation in 2<sup>nd</sup>–3<sup>rd</sup> parity dams ( $284 \pm 1$  days). To sum up, our results suggest significant role of calving season in relation to milk yield and significant effect of dams' parity on gestation length.

**Keywords:** milk yield, gestation, calving season, parity, dairy cows

### 1 Introduction

Environment is considerably affecting dairy cows' production as well as reproduction. In this respect some authors reported role of calving season on the future milk production (Barash et al., 1996; Froidmont et al., 2013) as well as on gestation length (Tomasek et al., 2017). Numerous authors suggested that this seasonal effect on dairy cows' milk yield could be mediated via photoperiod (Dahl and Petitclerc, 2003; Rius and Dahl, 2006; Barash et al., 1996), and very importantly by changes in temperatures (Dahl et al., 2016), especially during the dry period (Dahl and Petitclerc, 2003). It was observed that short-day photoperiod and also absence of heat stress during late gestation of dairy cows could improve their performance (Tao et al., 2019). Additionally, calving season might not be affecting only cows' milk production, but could possibly affect also future performance of dairy cows' offsprings (Tančin et al., 2018), by lowering the milk yield on their first and second lactation (Tao et al., 2019).

In terms of gestation length, Wright et al. (2014) reported shortening of gestation length due to higher temperatures. Moreover, shorter gestation length may reduce the time of foetal growth, resulting in worsened performance of dams'

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as well as calves (Tao et al., 2019). Nevertheless, Tomasek et al. (2017) indicated season of calving as more important factor affecting gestation length. Moreover, gestation length could be affected also by dams' parity (Tomasek et al., 2017), where younger cows had shorter gestation compared to older cows (Norman et al., 2009).

Similarly, higher parity dams tend to have higher milk yields (Ceyhan et al., 2015), that was previously demonstrated by several other authors, whereas highest yields were observed at 4<sup>th</sup> or 5<sup>th</sup> lactation (Mellado et al., 2011). Furthermore, dams' parity could also affect performance of their daughters (Mikláš et al., 2020), as Storli et al. (2014), reported that daughters born to older dams produced less milk.

For that reason, we have decided to examine the effect of calving season and to verify also impact of the dams parity on milk yield and gestation length.

## 2 Material and methods

### 2.1 Animals and farm management

The data (93 animals) were collected from the commercial farm located in Lower Váh region (Western Slovakia). The examined herd comprised of Slovak spotted breed. Dairy cows' calvings were recorded over period of 4 years (2014–2017), consisting of cows on their first to sixth lactation. In the observed farm both free-stall housing with cubicles and deep-bedded system was utilized for lactating cows. The average milk yield in the examined group of animals was  $8,133 \pm 1,380$  kg. Calves in the farm were shortly after birth moved to individual calf hutches outside, where they were firstly fed with colostrum, then whole milk, which was on the third week replaced by the milk replacer.

### 2.2 Statistical analyses

Statistical analyses were carried out using the SAS® software (SAS Studio 3.8, 2018). The Shapiro-Wilk test was used to test the normality of the distribution of all variables. For the analysis of milk yield variable we utilized general linear model (PROC GLM), with which we examined the effect of calving season and dams' parity. The effect of calving season and dams' parity on gestation length was examined by the nonparametric Wilcoxon's rank-sum test (PROC NPAR1WAY), as it was not normally distributed. The factor of calving season was divided into four groups: spring (March to May), summer (June to August), autumn (September to November) and winter (December to February). The dams parity was divided into three categories: 1<sup>st</sup> parity cows, 2<sup>nd</sup>–3<sup>rd</sup> parity cows, 4<sup>th</sup> and higher parity cows. Statistical significance was declared at  $P < 0.05$  and tendency at  $0.05 < P < 0.1$ .

## 3 Results and discussion

In our study calving season significantly influenced 305-d milk yield of the examined dairy cows. The highest 305-d milk yield was observed in winter calvings and the lowest milk yields were found in animals that calved in spring (Table 1). The difference in 305-d milk production between these two seasons was more than 1,500 kg. Comparable results were published by Maciuc et al. (2009) and Rayet al. (1992), nevertheless the difference between calving seasons' milk production were not so substantial. Similarly Mikláš et al. (2019a) observed that calving season tended to influence the milk yield of dairy cows on their first lactation, nevertheless the calving season affected the observed animals differently.

We also examined effect of dams' parity on milk yield, where we observed that animals on their fourth and higher lactation had highest milk yields (Table 2). In this respect several studies reported that increasing lactation number is related to higher milk yields (Mellado et al., 2011). This might be comparable with our findings, but only partially, as we found that 1<sup>st</sup> lactation milk yields of examined dairy cows were higher compared to 2<sup>nd</sup> and 3<sup>rd</sup> lactations (Table 2).

Effect of calving season on gestation length was insignificant. Nevertheless, our findings were numerically comparable with the studies of Mikláš et al. (2019b) who in one dairy herd observed longest gestation lengths in winter and partially also with the work of Tomasek et al. (2017). Some authors explain these changes by variable temperatures at calvings, with shortest gestation lengths in summer (Wright et al., 2014). However, we did not confirm this suggestion. On the other hand Norman et al. (2009) observed association between milk yield and gestation length, that could be confirmed also in our study, where dairy cows that calved in spring had the shortest gestation length as well as the lowest average 305-d milk yields.

**Table 1** Impact of calving season on 305-d milk yield (kg)

Calving season	<i>n</i>	305-d milk yield (kg)
Spring	19	7,377 ±287
Summer	16	7,833 ±313
Autumn	25	7,833 ±250
Winter	33	8,942 ±218
<i>p</i> value		<0.01

**Table 2** Impact of dams' parity on 305-d milk yield (kg)

Dams' parity	<i>n</i>	305-d milk yield (kg)
1 <sup>st</sup>	27	8,123 ±264
2 <sup>nd</sup> –3 <sup>rd</sup>	38	7,884 ±223
4 <sup>th</sup> and higher	28	8,481 ±259
<i>p</i> value		<0.22

**Table 3** Impact of calving season on gestation length (days)

Calving season	<i>n</i>	Gestation length (days)
Spring	19	279 ±2
Summer	16	281 ±1
Autumn	25	282 ±2
Winter	33	284 ±2
<i>p</i> value		<0.32

Dams' parity significantly influenced gestation length of examined cows. The shortest gestation length was observed in animals on their first lactation and the longest gestation in dairy cows on their fourth and higher lactation (Table 4). That is comparable by other studies which reported that older cows had longer gestation lengths (Norman et al., 2009).

**Table 4** Impact of dams' parity on gestation length (days)

Dams' parity	<i>n</i>	Gestation length (days)
1 <sup>st</sup>	27	278 ±2
2 <sup>nd</sup> –3 <sup>rd</sup>	38	284 ±1
4 <sup>th</sup> and higher	28	283 ±2
<i>p</i> value		<0.02

#### 4 Conclusions

Significant effect of calving season on dairy cows' milk yield, as well as its effect on gestation length, could point on important role of environment, especially on the role of temperatures and possibly also photoperiod. However mechanism behind this effect remains uncertain.

Numerical increase in milk yield with higher dams' parity might rise the importance of increasing longevity of dairy cows, as it might improve economic sustainability of farms, as dairy cows on higher lactation produce more milk.

Moreover, we observed that higher dams' parity could be connected with the longer gestation length, which could possibly improve birth weight and by that also milk yields of dairy cows' offsprings.

Therefore further investigation of factors affecting milk yield and gestation length of dairy cows is needed as, according to our observation, it might improve dairy cows' production and possibly farm management.

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